REMARKS

New claims 11 to 19 presented for examination are based upon claims 1 to 5 and 7 to 9 in the parent case. The new claims further define the base part and the disposition of each of the entrance lens part, the exit lens part, and the light absorbing layer.

The specification has been amended to correspond to the specification in the parent case.

An early examination of claims 11 to 19 is earnestly solicited.

Respectfully submitted,

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increase the black stripe ratio, i.e., the ratio of the area of the black stripes to the area of the entire exit surface of the lenticular lens sheet.

However, further increase in the black ~~strip~~ stripe ratio of the foregoing conventional rear projection screen is difficult, because three color images are projected by separate projectors, such as CRTs, and the angles between the respective optical axes of the projectors are increased progressively for the reduction of the overall thickness of the rear projection television system.

The foregoing lenticular lens sheet is capable of diffusing light only in horizontal directions owing to the shape of its lenses. Therefore, the lenticular lens sheet contains optical diffusing particles(diffusing material) to diffuse light in vertical planes. The optical diffusing particles diffuse image light rays projected on the lenticular lens sheet and external light fallen on the exit surface to generate stray light rays in the lenticular lens sheet. The stray light rays thus generated deteriorates contrast in images. A means for suppressing the deterioration of contrast in images tints the entire lenticular lens sheet (body tinting), the contrast improving effect of which, however, is not necessarily satisfactory, considering reduction in transmittance attributable to tinting.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a lenticular lens sheet capable of enhancing contrast in images without reducing the intensity of projected optical images by suppressing the reflection of external light and of reducing the overall thickness of a rear projection television system employing the lenticular lens sheet, and to provide a rear projection screen employing such a lenticular lens sheet.

According to one aspect of the present invention, a lenticular lens sheet having an entrance surface and an exit surface comprises: a base part; an entrance lens part forming the entrance surface and having an array of a plurality of convex lens elements capable of gathering light rays; and a light absorbing layer formed in light-nongathering regions in the exit surface in which light rays

$\sin[(\sin 90°)/n] = (\pi/4) - \arcsin(1/n)$, the effect of the present invention is available.

A method of forming the tinted layer 13 of each of the lenticular lens sheets 10, 10A and 10B embodying the present invention, the color, the color density, the size and the thickness of the tinted layer 13 will be explained hereinafter.

Method of Forming Tinted Layer

The tinted layer 13 can be formed by mixing or dispersing a dye or fine particles of a pigment in a resin for forming each of the lenticular lens sheets 10, 10A and 10B.

Color of Tinted Layer

The tinted layer 13 may be tinted an achromatic color, such as gray, or a color capable of selectively absorbing or transmitting specific colors for controlling the balance of the three primary colors (red, green and blue).

Color Density of Tinted Layer

The color density of the tinted layer 13 is higher than those of a portion of the lenticular lens sheet other than the tinted layer 13, i.e., the base part 15, and portions of the entrance convex lens elements of the entrance lens part 12 other than the tinted layer 13. It is preferable that the respective color densities of the base part 15 and portions of the entrance convex lens elements of the entrance lens part 12 other than the tinted layer 13 are naught or are limited to a very low value to suppress the adverse effect of the external light rays without significantly reducing the transmittance to the image light rays projected by the image light source.

More concretely, it is preferable that the tinted layer 13 is colored in a color density such that the transmittance of each of the lenticular lens sheets 10, 10A and 10B is in the range of 40% to 70%. Whereas the transmittance to the image light rays increases, the intensity of the external light rays reflected in a total reflection mode by the entrance lens part 12 toward the exit surface 14 increase to deteriorate ~~contrast~~ contrast in images if the tinted layer 13 is tinted in a low color density such that the transmittance of the lenticular lens sheet is greater than 70%. The transmittance to the image light rays decreases and the relative inten-

tively. Each of the rear projection screens 1A, 1B, 1C and 1D employs the lenticular lens sheet 10, 10H, and a front panel 30A, 30B, 30C and 30D disposed on the exit side of the lenticular lens sheet 10.

Most lenticular lens sheets are formed of a material containing a light diffusing material to provide the lenticular lens sheets with a vertical diffusion characteristic. Part of image light rays is diffused in stray light rays and the stray light rays ~~goes~~ go out of the lenticular lens sheet through exit lens elements other than intended ones. In the lenticular lens sheet 10 shown in Fig. 2, some of the external light rays B incident on the exit lens part 17 goes out of the lenticular lens sheet 10 through the entrance lens part 12 without being reflected in a total reflection mode by the entrance lens part 12.

In those embodiments, a tinted layer is formed on the exit side of a lenticular lens sheet formed of a resin containing a light diffusing material to prevent the deterioration of contrast attributable to the light diffusing material.

The rear projection screen 1A shown in Fig. 15A is formed by disposing a front panel 30A in front of the lenticular lens sheet 10. The front panel 30A is formed entirely of a tinted base part 31A.

The rear projection screen 1B shown in Fig. 15B is formed by disposing a front panel 30B in front of the lenticular lens sheet 10. The front panel 30B comprises a transparent base part 31B and a tinted layer 32B formed on the exit surface of the base part 31B.

The rear projection screen 1C shown in Fig. 15C is formed by disposing a front panel 30C in front of the lenticular lens sheet 10. The front panel 30C comprises a transparent base part 31C and a tinted layer 32C formed on the entrance surface of the base part 31C.

The rear projection screen 1D shown in Fig. 15D has a lenticular lens sheet 10H similar in construction to the lenticular lens sheet 10 and provided with a tinted exit lens part 13H forming an exit surface 14. The rear projection screen 1D is constructed by disposing a front panel 30D formed entirely of a transparent base part 31D in front of the lenticular lens sheet 10H. The front pan-

els 30A, 30B, 30C and 30D may be provided with functional layers, such as an antireflection layer, a low-reflection layer, a polarizing filter layer, an antistatic layer, a glareproof layer and/or hard coating layer.

The present invention is not limited in practical application to the preferred embodiments specifically described above.

For example, the entrance lens part may be provided with a 'fly-eye lens sheet' capable of diffusing light in vertical planes instead of the lenticular lens elements.

The front panel may be provided with, for example, tinted lenticular lenses for vertical diffusion on its entrance surface. Since the lenticular lenses reflect unnecessary light rays, such as external light rays and stray light rays, in a total reflection mode, the formation of the tinted lenticular lenses on the entrance surface is more effective than uniformly tinting the front panel in displaying images in satisfactory contrast.

Examples

Lenticular lens sheets with black stripes in Example, Comparative examples 1 and 2 were made. The lenticular lens sheets were similar in construction to the lenticular lens sheet 10 shown in Fig. 2. In each of the lenticular lens sheets in Example, Comparative examples 1 and 2, the pitch of the lenticular lenses of the entrance lens part was 0.72 mm, the distance between the entrance lens part and the exit lens part was 0.87 mm, the lenticular lenses of the entrance and the exit lens part were convex lenticular lenses, and the black ~~strip~~ stripe ratio was 50%. The lenticular lens sheet in Example was provided with a tinted layer of 0.14 mm in thickness. The lenticular lens sheet in Comparative example 1 was provided with a lightly tinted layer, and the lenticular lens sheet in Comparative example 2 was not provided with any tinted layer. The properties of the lenticular lens sheets were measured. Measured results are tabulated in Table 2.

Table 2

	Example	Comp. Ex. 1	Comp. Ex. 2
Transmittance (%)	68	76	67